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VISION SCREENING IN FOUR COUNTIES OF IOWA.

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DESCRIPTORS- *EXCEPTIONAL CHILD RESEARCH, *TESTS, *IDENTIFICATION, *VISUALLY HANDICAPPED, REFERRAL, SCREENING TESTS, VISION, VISION TESTS, GRADES (SCHOLASTIC), ELEMENTARY GRADES, PRIMARY GRADES, INTERMEDIATE GRADES, SECONDARY GRADES, COMPARATIVE ANALYSIS, SNELLEN CHART, READING CARD SNELLEN RATING, KEYSTONE VISUAL SURVEY TESTS, T/O SCHOOL VISION TESTER,

FOUR VISION SCREENING METHODS WERE STUDIED DURING THE 1966-67 SCHOOL YEAR IN FOUR SELECTED SCHOOLS WITHIN A FOUR COUNTY AREA IN IOWA SCREENING METHODS STUDIED WERE (1) SNELLEN CHART FOR DISTANCE VISION, (2) SNELLEN CHART FOR DISTANCE PLUS THE READING CARD-SNELLEN RATING FOR NEAR-POINT TESTING, (3) KEYSTONE VISUAL SURVEY TESTS, AND (4) T/O SCHOOL VISION TESTER. A TOTAL OF 4,227 STUDENTS FROM KINDERGARTEN THROUGH GRADE 12 WERE SCREENED IN THE FALL OF 1966. PERCENTAGES REFERRED BY EACH OF THE METHODS RESPECTIVELY WERE 7.2 PERCENT, 6.7 PERCENT, 8.5 PERCENT, AND 11.2 PERCENT. A SERIES OF TABLES INDICATES NUMBERS OF REFERRALS BY GRADE LEVELS. OF THE REFERRALS WHO WERE SEEN BY EYE SPECIALISTS THE OVER-REFERRALS (FALSE POSITIVE) RESPECITVELY WERE 4 PERCENT, 6.7 PERCENT, 3.8 PERCENT, AND 2.2 PERCENT. AMONG THE CONCLUSIONS WERE THE FOLLOWING--(1) NO METHOD IS CLEARLY SUPERIOR TO THE OTHERS, (2) EACH METHOD APPEARS CONSERVATIVE IN DISCLOSING NUMBERS IN NEED OF EYE CARE, (3) THE MAJORITY OF REFERRALS WERE BETWEEN THRID GRADE AND NINTH GRADE, (4) HIGH PERCENTAGES OF REFERRALS RECEIVE PROFESSIONAL EXAMINATION INDICATIVE OF A GOOD FOLLOWUP PROGRAMS, (5) THE SNELLEN CHART, A PART OF EVERY SCREENING METHOD USED, REFERRED A MAJORITY OF STUDENTS RECEIVING REFERRALS. WHILE CORRECT REFERRALS RANGED FROM 93.3 PERCENT TO 97.8 PERCENT, THERE WERE POSSIBLY CHILDREN WHO PASSED THE SCREENING TEST BUT WHO MAY HAVE NEEDED PROFESSIONAL ATTENTION. A BIBLIOGRAPHY CONTAINS 65 ITEMS. (DF)

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INTRODUCTION

Since most learning is acquired through the sense of sight, it is necessary to meet the eye health needs of children. School vision screening programs are an attempt to detect as early as possible those students who need professional eye care. Vision screening programs are a necessity until the ideal goal is reached of a complete, professional eye examination for every child before he enters school and at stated intervals during his life.

School nurses and other school personnel in Buena Vista, Cherokee, Crawford, and Ida counties of Iowa wanted more information and recommendations for school vision screening than was available to them locally. Many of the nurses employed by the schools were not familiar with school vision screening procedures even though they were expected by their administrators to carry out such a program. The Office of Special Education in Storm Lake which serves these counties was contacted several times by nurses who wanted some type of guidance or recommendations about vision screening. Sufficient information was not available from the Office of Special Education to provide the answers the nurses

wanted or needed. No staff member had much training or knowledge in the area of vision screening. Since the itinerant teacher for visually handicapped children served in a secondary role as consultant in vision, she was presented with this problem.

The purpose of the present study was to enable the investigator to help school nurses in the four county area served by the Office of Special Education set up and carry out their vision screening programs. By reviewing the literature in the field of vision screening and using the results of a study done locally this purpose could be accomplished. Even though all schools in the four county area have vision screening programs, only four different methods are used. Four schools, each of which employed an experienced school nurse familiar with the particular screening instrument she used, were chosen to represent each of the four methods. The four vision screening methods were compared. Percentages of students referred for examinations by eye specialists were compiled. A follow-up study of what happened to these students as a result of their visits to the eye specialists was made. A careful look was taken at the numbers of students referred for professional examinations from

various grade levels.

The geographic area where the study was made consists of four counties located in northwest Iowa. The communities located in the four counties are mainly small towns where the people earn their livings in farm-related occupations. The land is particularly good for farming and corn is the main crop. The largest community in the area is a county seat town with a population of approximately 8000.

The total school population in these four counties is 16,750. There are 22 consolidated and independent public school districts with 55 attendance centers in the four counties. Rural children are transported by bus to the attendance centers. Each school district has its own board of education and administrators. Each county unit has a county board of education comprised of individuals elected by the school districts and a county superintendent hired by the county board of education.

The four counties cooperate for financial reasons to provide special education services for the public schools. It would be impossible financially for one county to provide a well rounded special education

program. The special education staff is hired by an advisory board made up of representatives of each of the four county boards of education and is approved by all members of the boards. The staff is composed of a director of special education, two school psychologists, four speech clinicians, the consultant for the retarded, the hearing clinician, the teacher for the hard-of-hearing, and the teacher for the visually handicapped. Seventeen classes for the educable and trainable mentally retarded children are maintained throughout the four counties and coordinated by the consultant for the retarded.

Twenty of the 22 school districts either employ a school nurse or are served by public health nurses who are in charge of the vision screening programs in the schools. In the other two school districts the Office of Special Education is responsible for the vision screening program. Every school in the four county area conducted some type of school vision screening. Every child in every grade in every school was screened. The screening methods were chosen by the nurses with no efforts being made to coordinate their work. There is no person whose job it is to coordinate

or advise the school nurses' programs since they are hired by their local school districts.

SURVEY OF LITERATURE

Vision screening is defined by Cunningham (1963, p. 2) as "...a gross test serving to indicate the probability, not the proof, of need for eye care." The purpose of vision screening programs is defined in several ways in the literature. Hathaway (1954, p. 175) stated, "Vision tests are given for the purpose of screening out those who appear to need ophthalmological attention." Emery (1962, p. 122) pointed out that the purpose of screening is "...to isolate the child who has a vision problem which will impede him in his learning at school." According to him, all other purposes are secondary. Bryson (1967) gives two purposes of vision screening. He states that we want to see if the child has learned to see with both eyes, and we want to have 20/20 vision in each eye of each individual if possible.

Strong support for school vision screening programs is found in the literature. Cunningham (p. 1) had stated that:

> "Every child, before entering school, should have a comprehensive professional eye examination. In schools where such an examination is not a prerequisite for entrance, careful visual screening should be started as early as possible and, in every school, screening should be done every year throughout the student's school life."

Von Noorden (1965) pointed out the extreme importance of screening young children for visual acuity. His reason (p. 143) was that the "...public is shockingly uninformed about the need of early treatment for amblyopia." The National Society for the Prevention of Blindness, Inc. (1961, p. 3) stated, "Vision screening programs for pre-school and school age children will be necessary until the ideal goal of annual professional eye examinations is reached." Statistical studies show 25 per cent of school age children have some eye difficulty and need professional care. Bryan (1962, p. 102) asserted:

> "Since all preschool children do not receive professional eye examinations it is doubly important to administer a well-planned and executed screening test at the time the child enters school. When at all possible such screening should be done annually."

Sloane (1965, p. 13) has written, "It is generally accepted that if we are going to help prevent blindness the early recognition of eye problems greatly increases our chances of success." Jones (1963, p. 11) supported vision screening with this statement, "Many visual impairments are prevented or their severity reduced when effective programs are provided for locating and referring children in need of care to eye specialists."

Wilson (1964, p. 79) further advocated vision testing for this reason:

> "One of the most significant facts to be picked up in the visual acuity test is the presence of a difference in acuity between the two eyes. Strabismus often is the cause of this inequality, and the inequality sometimes leads to strabismus."

Gallagher (1964) indicated that failure in reading or spelling may be because of poor vision. There are other causes, also, he points out, but early detection of the problem is important, no matter what it is. As an indication of the need for screening, Foote and Downing (1955, p. 2) declared:

> "Changes take place in the eyes of some adolescents, resulting in impaired vision and other defects. At the same time, the curriculum makes greater demands of their visual capacities than was true in lower grades."

It should be understood that school vision screening programs are not a substitute for complete professional examinations. Screening programs only detect the majority of those who may benefit from professional evaluations. Scobee (1948, p. 183) noted, "Any child who is not keeping up with his fellows deserves a complete ophthalmologic examination...." He felt that children will not report their own eye problems because:

> "Children do not complain of poor vision. If they happen to be nearsighted they don't know what there is to see, so they are not aware that they are missing something. If they happen to be far-sighted they see as much as they can and they unconsciously stop paying attention when the strain becomes too great."

The National Society for the Prevention of Blindness, Inc. (1961, pp. 7-8) said:

> "All children who are having reading difficulties, who are experiencing scholastic failure, who are suspected of being mentally retarded, and those who have cerebral palsy should have thorough, professional eye examinations. No vision screening procedure, regardless of how complicated or expensive, can be a substitute for a complete professional eye examination."

The Committee Report of New England Ophthalmological Society and Massachusetts Society of Ophthalmology and Otolaryngology (1953, p. 224) maintained that "...every child who seems to have eye symptoms should be given the benefit of an eye examination."

School vision screening programs date back to 1899 when state supported school vision testing programs were initiated in Connecticut. The methods used for testing are discussed at length in the literature. Sloane and Rosenthal (1960) wrote that the Snellen Test was the only test available for many years. In 1934 Betts devised a test which was released with the Keystone

Ophthalmic Telebinocular, the first commercial stereopsis vision testing instrument. These cards were designed to measure visual skills believed to be related to reading ability. A high number of over-referrals resulted when the Telebinocular was used in school health departments by persons not fully informed or without medical supervision.

Sloane and Rosenthal (p. 764) have described the Massachusetts Vision Test:

> "It employed tests to detect latent errors of binocularity and hypermetropia as well as reduced vision. It was also designed to incorporate a pass-fail scoring system which terminated with the first failure and did not appear to indicate the degree of defect to the lay person administering the test. This basic screening unit has gained wide acceptance and in 1947 it was approved by the A. M. A."

Cunningham stated that the Massachusetts Department of Public Health developed the Massachusetts Vision Test in 1938. The test consists of subtests for distance central visual acuity with an illuminated Snellen E chart; a plus-lens test for hyperopia, in which the visual acuity is checked with the student wearing a pair of plus lenses; and tests for vertical and horizontal muscle imbalance at twenty feet, and for near horizontal muscle imbalance at reading distance.

Various other screening instruments were developed and placed on the market, but studies have questioned their reliability. Shaffer (1948) reported a study done in Columbus, Ohio, where 188 children in grades one through eleven were tested using teacher observation, the Snellen E chart, the Massachusetts test, and the Keystone Telebinocular. Shaffer concluded that the Snellen test was the most reliable single screening method. The Keystone test had a high over-referral rate and was not significantly more accurate. The Massachusetts test had too high an under-referral rate and teacher observation was unreliable.

In February, 1948 to May, 1949 a study was done in St. Louis by Crane, Foote, Scobee, and Green in an attempt to evaluate effectiveness of vision screening at two grade levels. They reported (1954) that 609 sixth graders and 606 first graders in fourteen schools were given screening examinations by technicians, nurses, and classroom teachers. A wide variety of screening methods was used. Each student was given a complete ophthalmological examination to establish criteria against which results of screening procedures were evaluated. Crane et al. (p. 2) found that "...the

multiple-test procedures gave more correct referrals, but in the absence of greater screening efficiency they also gave a higher proportion of over-referrals." They also found (p. 2) that "No marked improvement in screening efficiency is found for the combination of a Near Vision Test with the Snellen over that for the Snellen alone...." Crane et al. (1952, p. 150) made the further statement "Snellen test, (20/20 referral basis), correctly refers about half of the students referred by ophthalmologists." On page 151 the authors concluded that "The study did not permit a conclusion that any one procedure or group of procedures is superior to the others."

Gutman (1956) reported on a study which included 6500 elementary school children in three Oregon counties. Children were screened with one or both of the test methods--either the Snellen test plus observation or the Massachusetts test. Conclusions reached by Gutman (p. 8) were:

> "By direct comparison both the Massachusetts Vision test and the Snellen test coupled with observation will, when performed by a trained operator, yield equivalent numbers of referrals for professional eye examination. One component common to both--the Snellen test--has a high degree of efficiency with but one 'over-referral' in seven when failure to read 20/30 with either eye is used as the criterion of referral; yet

> it discloses from two-thirds to three-fourths of all cases professionally meriting care. The subsidiary tests--plus lens, Maddox rod, or observation--produce an additional small group of cases which merit care but do so with a high ratio of over-referrals. The importance of finding these additional cases must be measured in terms of cost to parent and community, in relation to the severity of cases thus found."

Blum, Peters, and Bettman (1959) reported on a study done in the Orinda Union School District of California. Children in first through the sixth grades were chosen for the test situation. They were given vision tests once each year in 1954, 1955, and 1956. Blum et al. (p. 113) stated:

> "Seven different screening methods were used. The screening results were compared with clinical evaluation of all referrals at the University of California School of Optometry and the Stanford University School of Medicine Department of Ophthalmology. Of the screening methods studied, the most efficient was the Modified Clinical Technique."

The modified clinical technique is defined (Blum et al., p. 14) as follows:

> "This battery of tests, given to each child by two optometrists, included visual acuity, objective estimate of refractive error by means of skiametry and lens bar with motion-picture cartoon for fixation, cover test far and near; observation and internal examination for pathology or anomalies if indicated. Referral was made by optometrist on his evaluation of his screening data. All tests were made through present glasses, if worn."

Blum, Peters, and Bettman reviewed other studies in their report. The North Carolina Study by Kelley was concerned with testing the vision skills of 213 pupils in grades one, five, and nine. The testing instrument was the Telebinocular. The screening scores were compared with intelligence scores, scholastic achievement, reading skill, and personal adjustment. Relations of apparent significance are shown to exist between the vision scores and the other test results.

According to Blum et al. (p. 7) the Toronto Study (1952), by Morgan, Crowford, Pashby, and Gaby, was done...

> "...to evaluate several vision-screening methods and make recommendations to departments of education in Canada....The report concludes that the Snellen illiterate E chart is adequate for kindergarten children with 20/30, the limit of passing; the Snellen number chart for grade one and Snellen letter chart for grades two to eight with 20/20, the limit of passing. The report further concludes that little emphasis should be placed on coordination problems--except for tropias, which should be referred for attention--in this age range."

The Shrewsbury Study (1952), by Yasuna and Green, used the Massachusetts Vision Kit only and tested 1575 children in grades one through twelve. The results of the study indicated that about one-third of the referrals

were considered as over-referrals. The most unreliable test of the battery, it was concluded, was the phoria measurement.

The Danbury Study (1955) by Leverett, and reported by Blum et al. (p. 8)...

> "...introduced several concepts never used before in vision-screening research studies. First the entire project was discussed with the optometrists and ophthalmologists in the Danbury area before the study was started. Second, those wearing glasses were treated separately from those not wearing glasses. The Massachusetts Vision Kit in a new form by American Optical Company was used to test 4662 children from kindergarten through the twelfth grade. All failures were retested, and those failing the retest were indicated for referral or inquiry....Reports from the doctors were analyzed for the correctness of the referral.... The analysis of these reports indicate that the MVK in this form refers few children unnecessarily...."

New York studies reported by Blum et al. (p. 9) included three reports, one by Sulzman and Davis, and one by O'Shea, and one by Stump. They noted:

> "A new model Ortho-Rater, the Bausch and Lomb New York School Vision Tester, was used for visual acuity tests for each eye, a plus sphere test, lateral phoria at distance and near, and vertical phoria at distance. Al three reports were concerned with a comparison of the MVK with the new stereoscopic charts for the Ortho-Rater....The results obtained with the two methods are remarkably similar, even though the experience and training of the testers using

> the New York School Vision Tester was varied. It must be stated, however, that, although it performs as well as the MVK, it does no better. Certainly the results indicate that in terms of screening efficiency the New York School Vision Tester must be rated as good as the MVK."

Reber (1964) reported on a study of procedures and methods of screening by the University of Houston College of Optometry. During the 1962-1963 school year, 2578 children were given screening tests by optometry students, and 475 or 18 per cent were referred for care. A retinoscopy test, visual acuity test, visual acuity test with +1.50 diopter lens, cover test for phorias and tropias both for distance and near, and external examinations of the ocular adnexa and internal examinations of the media aided by an ophthalmoscope were given. Results showed that two-thirds of the students were referred for myopic reasons.

Other studies cited in the literature give a variety of information. Belloc (1962) reported that all states do some vision screening for their school children. Her study showed that, while screening can be done by a variety of professional and non-professional persons, most of it is done by nurses and/or teachers. Most states use the Snellen wall chart in the elementary

grades but not necessarily in the high school. The most common basis for referral is 20/30 on the Snellen chart.

Oberman (1966) reported a study done by School Health Section of the Division of Community Health Services, Public Health Service which showed that the most commonly used devices in vision screening were the Snellen chart and Massachusetts Vision Test. He has said (p. 222), "Screening programs for vision are of no value if provision is not made for adequate follow-up of suspected cases and referral for treatment." He found that whether parents carry out recommendations depended on financial status, availability of community resources, and level of parental education.

Knox (1953, p. 97) reported a study "...designed to determine the accuracy with which a check list of visual symptoms could be used to identify pupils in need of professional visual examinations." A check list of thirty items was used and 126 third graders were observed. Forty seven pupils were referred on the basis of observation, and 41 pupils were referred on the vision screening test. There were 24 pupils referred by both methods. Knox (p. 101) concluded, "Neither observation of symptoms nor visual screening

tests alone identify all pupils in need of visual care, but a combination of the two is more likely to be accurate."

One of the criticisms of school vision screening is that poor illumination of the Snellen charts leads to incorrect referrals. In a study by Kephart and Deutsch (1954), 55 college students were tested on a standard Ortho-Rater machine and the illumination levels were changed. The study showed that increases or decreases in illumination as great as one-fourth of the standard did not affect acuity scores on distance testing. Near acuity scores suffered when illumination was decreased more than 25 per cent.

A study in Boston reported by Donabedian and Rosenfeld (1957) included first grade students screened for distance acuity. A second tester without knowledge of the first tests screened the same children. These researchers (p. 157) found that "Both testers agreed closely on a failure rate of approximately of six per cent." They agreed on 95 per cent of the total as to the status of vision, but the rate of agreement of those that failed the test was 45 per cent. Donabedian and Rosenfeld (1957) found that tests are more reliable when

administered repeatedly by a single examiner.

Gregg (1957a, p. 23) gave the following report:

> "An eight-year study at Ohio State University showed a close co-ordination between vision and scholarship. Researchers found that no children with normal vision failed a battery of scholastic tests, while 37 per cent of the children with visual problems failed."

He stated that many of the children could pass the Snellen test, but they all had symptoms of eye trouble. He concluded that school personnel and parents should be alert for signs of vision problems.

In a unique study in New Haven, Connecticut, 401 students were screened using the Snellen chart, plus sphere lens, test for muscle imbalance and test for depth perception. Robinson and Wright (1959) reported that 79 per cent of the pupils passed the test while 20.8 per cent failed the test. Of the pupils who failed the screening test, 49 were examined by ophthalmologists and 69.4 per cent were felt to be over-referrals. Forty-six of the same pupils were examined by optometrists and 6 per cent were considered over-referrals. The authors (p. 433) concluded, "...lack of agreement among those who examine children's vision is one reason why it is so difficult to obtain satisfactory evaluation of visual

screening devices."

The Sight Saving Review (Eye examination..., 1962, p. 152) reported a study done in St. Louis where 100 poor readers had ophthalmological examinations. That report stated, "...while correction of ocular conditions may not cure reading problems, handicaps of any sort should not go unrecognized, and progressive conditions should be detected as early as possible."

Rosen (1966) cited a study in Minneapolis where 663 first graders were given a battery of screening tests including cover tests at near, nearpoint of convergence test, fixation, rotation, and retinoscopy. The study found 16.27 per cent of the pupils required professional eye care. Rosen (p. 449) inferred:

> "The findings provide further evidence regarding the necessity for improving school vision screening procedures in which distance visual acuity alone constitutes the sole approach to screening....Although it is seldom possible from a practical point of view to bring professionally trained personnel into the operational level of school vision screening, it seems that any approach short of this is only a compromise in the effective visual screening of young pupils. Whatever personnel are available for these purposes, it seems essential that the visual screening procedure be as comprehensive as possible so that maximum effectiveness and efficiency is realized."

Programs for vision screening throughout the United

States were described in the literature. In Illinois (Gray, 1949) a committee planned the vision screening program. They chose the Massachusetts Vision Test as a method for vision screening to be done annually by a properly qualified lay person. The referral criterion was failure on the 20/20 line of the Snellen test or those who had obvious or questionable pathological alteration. Askew (1958) reported on the Illinois program using the Massachusetts Vision Test standards. She stated that professional opinion varied, so some referrals are unavoidable, but they wanted to keep them at a minimum. She reported that they did not have the problem with over-referrals that the St. Louis study had shown. Their over-referral rate was around 10 per cent. She felt that rechecking before referrals were made cut down on the over-referrals. Volunteers were trained to do school vision screening by staff members of the Illinois Society for the Prevention of Blindness. This practice was advantageous to the program because the volunteers became community leaders in support of school health programs.

In Lincoln, Nebraska, complaints from school personnel and eye specialists that screening was

inadequate with Snellen cards led to a survey and recommendations for a new program. J. C. Thompson (1958, p. 251) reported:

> "The Medical Advisory Committee recommends that the screening program be limited to acuity and selective hyperopia tests. The infrequence of phorias and other visual defects does not justify more extensive testing which would require the use of more expensive instruments. It is therefore recommended that each nurse be equipped with one portable, illuminated Snellen case and one pair of lenses (+2.00 diopters). This program should result in a minimum of incorrect referrals, according to the Advisory Committee."

Pennsylvania began giving screening tests for visual acuity, hyperopia, and muscle imbalance in 1959. Martz (1959, p. 13) made this point: "In reporting to parents, never at any time imply that glasses are needed. This only serves to strengthen the popular misconception that glasses are the cure-all for eye difficulties."

Mary A. Thompson (1959) reported that the Massachusetts test was used in Prince George's County, Maryland. Children in grades one, three, five, eight, and eleven plus those referred from other grades were screened. In 1958 color screening was added for fifth grade boys. The purpose of color screening was to have

information available that might affect career planning.

South Carolina vision screening programs used volunteers to screen children with the Snellen chart. Careful teacher observation was included in their program (Free, 1959).

The following recommendations for Richmond, Virginia, were reported by Arrington (1961): 1) screening is not diagnostic, so do not report those passing; 2) the purpose of screening is to determine referability, not acuity; 3) use 20/20 if the child is over ten and 20/30 if the child is under ten for referral criteria; 4) children should be retested before referrals are made; 5) use only the 20/20 and 20/30 lines on the chart--reading the rest wastes time; 6) use an internally illuminated chart; 7) do not use binocular stereoscopic tests; 8) do not test for phorias (only two per cent are referred by best screener); 9) refer children showing symptoms of eye problems; 10) examine each child individually.

In reporting on school vision screening in Michigan, Blackhurst (1964, p. 8) stated, "One of the first considerations in setting up a vision screening program is that of standards." The Snellen test is popular in

Michigan because it finds large numbers of children with vision defects, a large percentage of failures need treatment by a doctor, and it is inexpensive and easy to administer. Blackhurst (p. 9) observed:

> "Educators who are interested in finding out why a child is doing poorly may see limited value in identifying myopic children and getting them treated to improve reading ability, for example. It is more likely that children who are hyperopic or those with a muscle balance problem are having difficulty in academic achievement."

Camery (1966) reported that the vision screening program in Pittsburgh had trained volunteers do the vision screening. The volunteers were supervised by professional nurses who were responsible for the referrals and the follow-up program. The nurses also helped teachers identify children who needed special attention because of vision problems. Such things as help with keeping glasses clean and properly adjusted, first aid treatment of eye injuries, and eye health habits were included.

An opinion on the persons choosing a screening test was expressed by Wilson (1964, p. 77).

> "The choice of a test for screening for a particular community can best be made by a local joint committee composed of school medical advisors, nurses, and educators, with consultation from local eye specialists."

General recommendations for screening programs were given by several authors. Ashcroft (1963, p. 421) has said:

> "A good program includes comprehensive screening for early discovery, referral for comprehensive eye-examinations for those who seem to have difficulties or symptoms indicating future problems, and follow-up to carry out recommendation of complete eye examination."

Sight Saving Review (Cooperation..., 1965, pp. 197-198) reported these statements:

> "...school screening tests should always be coordinated with the program of instruction.... Parents should be fully aware that the vision screening is not diagnostic....The instruction program includes good eye care and safety measures."

The National Society for the Prevention of Blindness (1958, p. 2) stated that the "screening process should include a history of complaints and illnesses and observation of appearance and behavior."

The Committee on Visual Problems in Schools (Bing, 1957, p. 454) gave the following recommendations:

> "We feel that visual screening should be a part of a larger vision conservation program which has as its aim prevention of visual difficulties which keep a child from achieving in terms of his ability. We feel it is important that the various groups concerned with a child's welfare in school should be involved in such a program. This would include the teacher...;

> the parents...; the vision and eye specialists in the community, the school nurse, and in addition, school administrative personnel. We feel that a school screening program must be kept practical in terms of cost, administrative ease, time, and number of children referred.... We also feel it is of utmost importance, because of the variation in what is conceived as being the visual factors which should be appraised in screening programs, that all concerned with the vision screening of school children be well informed as to the limitations of any screening program, and that the passing of a screening test or even a battery of tests is no guarantee that a child does not have defective vision or malfunction serious enough to require treatment."

Scobee (p. 97) contributed this observation about referrals from school vision screening programs:

> "Even the most carefully conducted screening examination by the school physician, using rather rigid criteria, will result in slightly more than fifty per cent of needless referrals. Such rigid criteria are necessary, however, if we are to reach every single child who actually needs attention. From the standpoint of the child's eyes and their importance in his life, it is perhaps not being too emotional to conclude that despite needless referrals, it is far better to err on the side of being safe than sorry."

Foote and Crane (p. 160) expressed a similar idea about referrals. "Failure to refer students who actually need the care of an eye specialist arouses less criticism because no one is aware that these children need care."

Gibbons (1965) pointed out that over-referrals would occur regardless of how well planned or organized the plan is. It is well for doctors to know about the screening program, then they can stress to parents the need for regular eye care rather than say the visit was not necessary. Sloane (p. 15) adds:

> "If there is going to be an error in any test it should be in the direction of over-referral rather than under-referral. It is better to send a patient for an extra examination than to miss a condition that needs treatment. However, there is bound to be criticism."

Recommendations for screening instruments are varied. The Committee on Child Health of the American Public Health Association and the National Society for the Prevention of Blindness (1956, p. 30) declared, "The Snellen Test is the most practical test for evaluating distance central visual acuity." It is inexpensive, easy to administer, quick; but it is not to be used for diagnosis. Gregg (1954, p. 45) made this statement:

> "The Snellen letter chart is perhaps still the most widely used screening device. It is an excellent test, it seldom refers a person who does not need care. At the same time, it passes many individuals who do not have good visual achievement. Today it is commonly known that clear distance vision alone, does not mean that vision is perfect....If it is not possible to provide more than a Snellen letter test, then

> extensive parent-teacher education concerning the symptoms of vision problems is essential."

Foote and Downing (p. 2) added:

> "Research on methods of screening for vision problems has revealed the highest correlation with professional findings for the Snellen test for distance acuity and for the Massachusetts Vision Test battery."

The Committee Report of New England Ophthalmological Society and Massachusetts Society of Ophthalmology and Otolaryngology (p. 224) concluded, "...no test on the market should be considered as the best ultimate test...." The Committee suggested that all tests should be reviewed periodically. Hathaway (p. 21) observed that "...no test will meet all situations....If only one test can be given, the Snellen test is the most desirable, supplemented by observation."

Recommended by the National Society for the Prevention of Blindness, Inc. (1961) as a basic screening procedure for school children is an annual test for distance visual acuity using the Snellen chart combined with teacher observation for symptoms that may be related to eye problems. The Society (p. 4) also noted, "Authorities agree that a careful, painstaking test for central distance visual acuity is the most important single test

of visual ability." More children are identified by a test for central distance visual acuity than by any other single test.

> "If a test for hyperopia is considered desirable the National Society recommends, first, the plus lens distance vision test. The near-vision test with cards held at 14 or 16 inches is not recommended as a routine procedure." (The Society, p. 5)

In order to carry out an adequate vision screening program the National Society (p. 9) felt that, "Community understanding of the purpose of screening is essential."

Recommendations for screening procedures are varied in the literature. Gregg (1957b) gave as the ideal school vision plan: 1) good vision screening with the Snellen letter tests, yearly, a plus sphere test, and some type of test to detect the cases of poor eye coordination; 2) teacher education on visual problems of children; 3) parent education; 4) cooperation of professional men in the community; 5) pupil instruction of visual health; and 6) good visual environment.

Weatherbe (1961) reported on the modified clinical technique which resulted from the Orinda Study. Recommendations of criteria for referral were visual acuity of 20/40 or less, refractive error, eye coordination

problems, organic problems, and any noted pathology.

Scobee suggested observing behavior and symptoms, testing for visual acuity, and checking for muscle imbalance as screening procedures. For good testing environment he also suggested familiarizing children with the test beforehand, encouraging shy children, and not hurrying.

Cromwell (1953) gave his recommendations for screening procedures. He said the majority of children with significant visual problems would be found by routine screening of kindergarten, first, third, and eighth grades. Re-screen annually those referred previously and screen all new entrants to the school. More time could then be given to careful observation. Refer children who complain of symptoms which might be related to eyes.

Cunningham (p. 3) made this statement in regard to screening methods in addition to Snellen testing:

> "In general, it should not be undertaken unless records show that from 85 to 90 per cent of children referred through Snellen testing coupled with teacher observation are receiving professional eye examinations. When the school wishes to introduce equipment in order to include more than Snellen testing the Massachusetts Vision Test offers the most reliable procedure."

Farrington (1961, pp. 95-97) offered these observations:

> "Any vision screening to be adequate in nature must consider more than a mere Snellen rating....Peter's study concludes that the Snellen test is not an adequate or efficient method of finding those children in an elementary school population who have vision problems....every vision problem does not affect visual acuity....The Snellen visual acuity will 'pass' significant numbers of children with vision problems, problems which most optometrists and ophthalmologists would agree should be referred."

For a screening program to be adequate Farrington felt that it must provide information about visual acuity, coordination for near and far, refractive status, and organic condition.

For making screening tests on pupil's eyes, House (1963) recommended the use of apparatus which approximates equipment used by eye specialists. He suggested having an eye physician guide an interested teacher in acquiring skills necessary to operate equipment.

Byrd (1955, p. 61) reported the following recommendations for screening procedures:

> "It has been recommended that the plus sphere test be used for the detection of far-sightedness in school children. The administration of the plus sphere test is not difficult or time-consuming. The test can be given by the classroom teacher and the testing equipment is

> relatively simple and inexpensive. It is reported that statistics show that approximately 7 per cent of all school children fail to pass the plus sphere test."

Criteria for screening procedures as suggested by the St. Louis study are good testing conditions, unhurried testing schedules, definite plans for repetition of tests so as to obtain reliable scores for all subtests. The Massachusetts Vision test is efficient to find more students who need care only when adequate follow-up is available. "It is unlikely that anything is to be gained by using procedures other than the Snellen, or possibly the Massachusetts Vision test, below third or fourth grade" (Crane, et al., 1954, p. 4).

Some writers criticized screening programs. Winebrenner (1952) stated that all vision problems could not be detected by school vision screening. Many problems may be present while the child is able to pass the test. She felt that there is a need to have close observation by parents and teachers who know for what to look.

Spache (1960, p. 32) said:

> "Many of the schools in our country still use antiquated methods of vision screening. Most of the children who are handicapped in school achievement by some visual difficulty are not detected by this type of screening."

Vetterli (1959, pp. 44-45) wrote:

> "Acceptance of the idea that '20/20 is perfect vision' leads to the neglect of other serious problems not necessarily associated with acuity, or sharpness. One of the most important is lack of efficient eye co-ordination....There can be no substitute for an annual examination in the office of a qualified vision specialist throughout the period of a child's school attendance. The ideal will not be attained (or even approached) so long as parents, teachers and school authorities believe in the myth of 20/20 vision. And each time the Snellen chart is used for screening, that myth is perpetuated."

Sloane and Rosenthal (p. 765) differed with Vetterli's point of view about annual vision examinations by a specialist:

> "It has been estimated that 20% to 30% of the 33,000,000 children of school age in this country suffer from visual defects that require professional care. Therefore, the ideal goal of periodic complete eye examinations for all children is, at the present time, impractical and, indeed, wasteful."

Who should do school vision screening has been covered in the literature with little difference in opinions. Ashcroft (p. 421) stated:

> "Adequate screening for visual problems can be carried out effectively only by people who understand the proper use of the vision screening devices, the purpose of the program, and the nature of the group with which they will be working."

Wilson felt that the Snellen test need not be administered

by a person with medical training, but the testing procedures must be standardized and results carefully evalated. Askew (1959, p. 63) suggested "...local school authorities should select the persons best suited to the job from those available in the community." The aptitudes needed would be understanding of children and ability to communicate effectively with them, educational background to understand the scientific approach, and acceptance of the restricted role. Askew stated that, if volunteers were used, they should not have pre-school children because of the demands made on their time. They should be persons likely to stay in the community in order to provide continuity in the screening program.

Sloane (p. 14) gave the following statement about professional eye specialists doing vision screening in schools:

> "National Society as well as New England Ophthalmological Society and other authorities who have considered this problem seriously have come to the conclusion that no ophthalmologist, optometrist or other practitioner should give tests in school."

The reason for not having any practitioner take part in school vision screening is persons may interpret the screening test as a complete eye examination. Sloane

(p. 14) continued:

> "We believe the screening should be done by people who are specially trained for it--may be teachers, nurses, volunteers who have acquired a certain fundamental amount of information. Teachers who are given the testing as a chore that is added to their many other duties may not have proper interest in it and get it done quickly, with a great amount of error."

Foote and Downing felt that a properly prepared teacher can screen as well as a nurse or special technician. Hathaway stated that screening is the responsibility of the school health service.

In the opinion of the Committee on Child Health it is often desirable for the regular classroom teacher to do the vision screening. She can correlate her knowledge and observations of the child in a wide variety of tasks with test results. Byerly (1961) suggested that nurses conduct in-service training if teachers are to do vision screening. In addition, the nurse may discuss at faculty meetings signs and symptoms of visual difficulty and typical behavior associated with it.

Follow-up methods were stressed by several authors. Bryan (p. 102) pointed out, "Regardless of the method used and careful administration of the test, however, the screening will accomplish little if follow-up is

neglected." She gave four points for follow-up: 1) referral; 2) see that child is actually taken to an eye specialist; 3) study ocular report to see if child needs any special eye attention at school; and 4) report any child with visual acuity of 20/70 or less to the proper school authority.

Cunningham (p. 8) said, "Adequate follow-up to insure that those referred are actually examined by well-qualified practitioners needs equal emphasis."

Gibbons (1965) suggested three phases of follow-up. Cooperation and coordination of everyone of the eye team is needed in order to see that pupils go to the doctor, to know where to seek financial aid, and to contact special educational services for help. It is important to recognize that screening is not diagnostic. There is a need for periodic re-evaluation of screening methods and those who do the screening must be well prepared. Gibbons (p. 431) continued:

> "Follow-up should include recognition of the value of safety lenses as an important guard to vision....Follow-up on school vision screening gives an opportunity to nurses and teachers to focus attention on evaluating classrooms for visual comfort....Follow-up can be a means of providing health education and services related to the eye as well as a means of identifying

those children with severe vision problems who can benefit from special education."

In personal communication with Miss Gibbons, she stressed...

"...the need for complete follow-up which goes beyond accomplishing treatment and possible prescription of lenses. It should include referral of those children whose corrected vision is 20/70 or less to appropriate school personnel, so that their needs for special educational services will be considered."

PROCEDURES

Four schools, each of which used a different method of vision screening, were selected from within a four county area. Each of the schools employed an experienced school nurse. Each nurse was familiar with the screening instrument which she used.

Each of the school nurses began the vision screening program early in the school year. Kindergartners were the last group to be given the screening tests, thus giving them some time to become accustomed to the school situation before the testing. Any student who failed the screening tests was given the test again at a later date. Referrals were made when students failed both the initial screening test and the recheck test. In the four schools the nurses had the screening, rechecking, and referring completed by the end of November. Referrals were made by letter. The parents were notified that their child could benefit from a professional eye examination. Attached to the letter was a form for the eye doctor to complete and return to the school. This enabled the school to know what correction had been made, if any, and what specific information the school needed to know about the child's eye problem.

No attempt was made on the part of any school to recommend which vision specialist the child was to see. Most of the children were seen by optometrists. Perhaps one of the reasons is because no ophthalmologist is located closer than fifty miles to any of the communities involved in the study.

In all schools nurses were concerned about children with symptoms of visual difficulties which did not necessarily show up on the screening tests. Such difficulties would include squinting, frowning, head tilting, headaches, dizziness, and blurred vision.

School A is located in a small farming community with a population of about 1500 persons. The school nurse gave a vision screening test to 811 students in all grades including kindergarten. The test was the Snellen card for distance vision only. The Snellen card measures 8½ by 11 inches and is made of heavy cardboard. The field is white with black letters arranged in five lines. The largest letters are at the top of the card. Each row of letters is proportionately smaller than the row of letters above it.

According to Farrell (1956, 1958), Snellen determined the size of the letters by choosing a visual angle

of five minutes. For the normal eye to see the letter clearly within the arc at 200 feet the letter had to be 3.48 inches square. When three arms of the letter E with the two interspaces were divided equally, each printed line subtended an angle of one minute.

The diameter of an average human cone is .004 millimeters. This corresponds almost exactly to one minute of arc on the retina. The smallest object which can be seen clearly at a given distance gives a retinal arc of one minute. The measure of visual acuity is determined by this (Kantar, 1963).

For use in vision testing, the Snellen card was fastened with tape or tacks to a blank wall on a level with the pupil's eyes. The chart was adequately lighted, but glare or direct light in the pupil's eyes was avoided. Pupils were instructed in the procedure before beginning the testing. The pupils stood exactly twenty feet from the chart. They were given a 3 by 5 stiff card to cover the eye not being tested. That eye was to remain open, however. The children were cautioned not to place any pressure on the eye being covered. Care was taken by the nurse to see that the child covered the eye completely. The child read across each row of letters that he could

see. For convenience, the child's right eye was tested first, then the left eye, then both eyes.

The nurse recorded for each eye the smallest line that was read with not more than one error. In recording, the result is written as a fraction. The numerator is the distance from the chart. The denominator is the line read. For instance, if the thirty-foot line is read with no more than one error, the result is written as 20/30. This is the measure of visual acuity and is not to be interpreted as a fraction.

If a child wore glasses, he was tested first wearing his glasses, then without them. Children who failed to read the 20/40 line with either eye were referred for professional care if they were in third grade or below. Children in fourth grade and above who failed the 20/30 line with either eye were referred for care.

School B is located in a town whose population is 900. In School B, 775 children in grades kindergarten through twelve were given screening evaluations. The procedure again was the Snellen card for distance. However, in addition, children in grades three through twelve were given a near-point test. The Reading Card - - Snellen Rating was used as the screening method for

near-point. The card is 4½ by 5½ inches with black letters on a white field. Short words of four letters each are placed in groups of varying size with the group of smallest letters at the top of the card. The card was held fifteen inches from the child's eyes and good illumination without glare was provided. The child was to keep both eyes open during the testing, but the eye not being tested was covered with a 3 by 5 card. No pressure was to be placed on the covered eye. The right eye was tested first, then the left eye and both eyes, first with glasses if glasses were worn, then without them. A child read words in the smallest group that he could see. If there were words that he did not know he was asked to give the letters. Results were expressed as a fraction. The numerator was the distance from the card. The denominator indicated the smallest group of words that could be seen by the child. Children who did not wear glasses, and whose test results were from 15/30 to 15/40 in either or both eyes, and children who wore glasses but scored from 15/30 to 15/40 in either or both eyes with their glasses, were referred by the nurse.

School C is located in the largest community of the four in the study. The community has a population

of approximately 5000. In School C the school nurse screened 1780 students in all grades. The initial vision screening was done early in the school year at the same time as the general health inspection. The Keystone Visual-Survey Tests were used. This screening procedure involves the use of a machine in which fourteen cards are placed. The Keystone cards test for simultaneous vision; vertical and lateral posture; fusion; usable vision in the right eye, left eye, and both eyes; and stereopsis, all at far point. Near-point cards test for lateral posture; fusion; and usable vision in the right eye, left eye, and both eyes. Cards for color perception are included in the testing materials. However, they were not used by the nurse as general testing procedure for every child every year.

The student was seated in a comfortable position with his back and head erect and shoulders level. The instrument was then adjusted to the required height to maintain the desired body posture. The child looked through the machine at the cards placed in the cardholder. The cards were prearranged by the nurse. She asked certain questions pertaining to the cards and then recorded the student's responses on a record form

provided with the machine.

Children in kindergarten and first grade who did not know the alphabet or who failed the machine testing were tested using the Snellen card. Young children were only given the test for far-point acuity. Only in third grade and above did the children receive the full battery of tests. Any child who failed the initial screening test was given a retest at a later date. If he failed the screening test once again, he then was referred for examination by an eye specialist.

Any child who had rated a score of 96 per cent on the far-point test in the fall was rechecked in the spring of the year. Any child who rated a score of 88 per cent on far-point or 80 per cent on near-point was referred for professional attention. The school nurse did not follow strict referral criteria on the tests for muscle imbalance. She indicated that in the past she had many over-referrals because of this subtest, so she has developed less rigid criteria for referral.

School D, located in a community of 2300 persons, included 861 students in grades kindergarten through twelve in its vision screening program. The school nurse did all of the vision testing with the T/O School

Vision Tester manufactured by the Titmus Optical Company with the exception of kindergarten and first grade. They played a game with the Snellen E chart for their screening tests.

The T/O School Vision Tester is an optical instrument that is sturdy and simple to operate. The viewing part can be raised or lowered and the forehead rests on a pad kept sanitary by disposable tissues. The child looked through the instrument which had been adjusted to a comfortable height for him. The nurse asked questions and recorded the child's responses about the six cards used in the screening test. The tests were administered under normal room illumination as the instrument is sufficiently hooded and protected so that outside illumination does not affect the results. It provides proper illumination for the cards. Care was taken to avoid glare. The far-point tests are presented at an optical distance of twenty feet by the use of prisms and mirrors. The near-point tests are at an optical distance of fourteen inches.

The correct slide for each test is brought into exact position by a dial turned by the nurse. The slides are arranged in order to test visual acuity first in the

right eye then in the left eye. A plus lens, 1.75 diopters, was then inserted in the machine to test the near-point acuity in either eye of the student. By turning the dial again, slides used to test muscle imbalance were seen by the child and his responses to the appropriate questions were recorded. Students were referred for a professional examination when they had a visual acuity below 20/30 in either eye on the far-point test, when they had an acuity through the plus lens of 20/20, or when they failed the muscle test.

The study was carried out from fall, 1966, and completed at the end of the 1966-1967 school year when the children had sufficient time to be seen by eye specialists. Results, when obtainable, of the follow-up examinations were recorded and compiled. There were some children who were not seen by eye specialists for one reason or another. However, the majority of students referred were seen by eye specialists; and treatment was obtained. Only through adequate follow-up programs were these results possible. In the four schools chosen for this study, the nurses carried out very extensive follow-up programs to evaluate the results they had obtained from their screening programs.

RESULTS OF STUDY

Information from the study of vision screening methods in a four-county area of Iowa was compiled at the end of the 1966-1967 school year. Figure 1 shows the percentages of students referred for professional care from each school. School A, which used the Snellen card for distance, referred 58 out of the 811 students screened or 7.15 per cent of its students for professional evaluation. Using the Snellen card for distance plus the Reading Card - - Snellen Rating for near-point testing, School B referred 52 out of 775 or 6.71 per cent of its students. In School C, 152 out of 1780 students or 8.54 per cent were referred to eye specialists by the school nurse who used the Keystone Visual-Survey Tests for screening. The T/O School Vision Tester was used in School D, and 96 of the 861 students, or 11.15 per cent, were referred for professional evaluation.

Tables 1, 2, 3, and 4 show the percentages of students referred in the four schools at each grade level. The students referred in each grade were then classified according to the particular screening test they failed. These numbers were computed as percentages

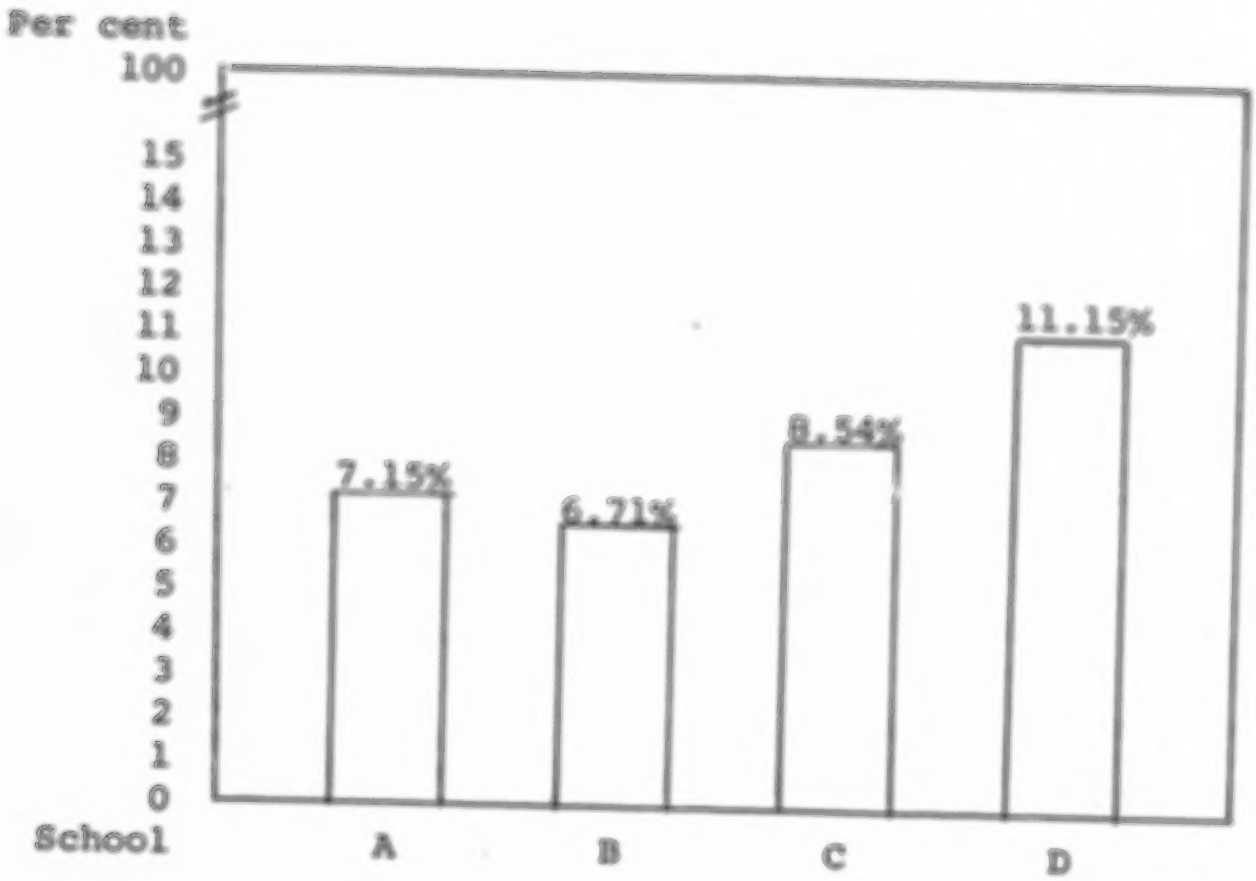

Fig. 1. Students Referred for Professional Examinations.

Table 1

Referrals per Grade
School A

Grade	Students Referred %	Distance Test %
Kdg.	0.0	0
1	0.0	0
2	5.6	100
3	6.6	100
4	8.2	100
5	8.8	100
6	16.7	100
7	10.4	100
8	12.1	100
9	12.9	100
10	4.3	100
11	3.2	100
12	1.7	100

Table 2

Referrals per Grade
School B

Grade	Students Referred %	Distance Test %	Near-point Test %
Kdg.	1.8	100	--
1	0.0	0	--
2	3.3	100	--
3	6.2	100	0
4	9.4	100	0
5	21.6	100	0
6	5.6	100	0
7	11.7	100	0
8	13.5	100	0
9	3.5	100	0
10	5.5	100	0
11	3.1	100	0
12	2.6	100	0

Table 3

Referrals per Grade
School C

Grade	Students Referred %	Distance Test %	Near Test %	Nurse's Observation %
Kdg.	2.6	100	--	0
1	2.0	100	--	0
2	11.2	79	0	21
3	6.0	67	17	17 *
4	8.9	80	0	20
5	19.5	89	6	6 *
6	17.1	96	4	0
7	13.2	79	5	16
8	9.8	81	0	19
9	10.2	71	6	23
10	6.9	58	0	42
11	4.0	67	0	33
12	3.9	83	0	17

*Due to rounding the totals are more than 100%.

Table 4

Referrals per Grade
School D

Grade	Students Referred %	Distance Test %	Near Test %	Muscle Test %
Kdg.	2.9	100	--	--
1	6.6	100	--	--
2	8.6	86	14	0
3	6.7	100	0	0
4	10.0	100	0	0
5	16.5	100	0	0
6	21.2	100	0	0
7	15.1	91	9	0
8	17.3	100	0	0
9	14.5	100	0	0
10	9.4	100	0	0
11	5.5	67	33	0
12	9.8	100	0	0

which are given in the tables, also. The distance test and near-point test shown in Table 3 for School C refer to the usable vision at far and near subtests of the Keystone Visual-Survey Tests. Students did not fail subtests other than those shown. The blank lines in Tables 2, 3, and 4 indicate that the test was not given in those grades.

Figure 2 is a line graph comparing the percentages of students referred for professional examinations at each grade level from the four schools. Total referrals per grade are graphed without regard to the reason for referral.

In School A, 50 of the 58 students referred, or 86.2 per cent, were actually seen by eye specialists. School B had 45 of its 52 referred students, or 86.5 per cent, seen by eye specialists. In School C, 132 of the 152 students who were referred, or 86.8 per cent, had appointments with eye specialists. Of the 96 students referred in School D, 92 or 95.8 per cent were seen by professional examiners. The information is graphed in Figure 3.

Figure 4 shows the percentages of correct referrals, or those students who were referred by the screening

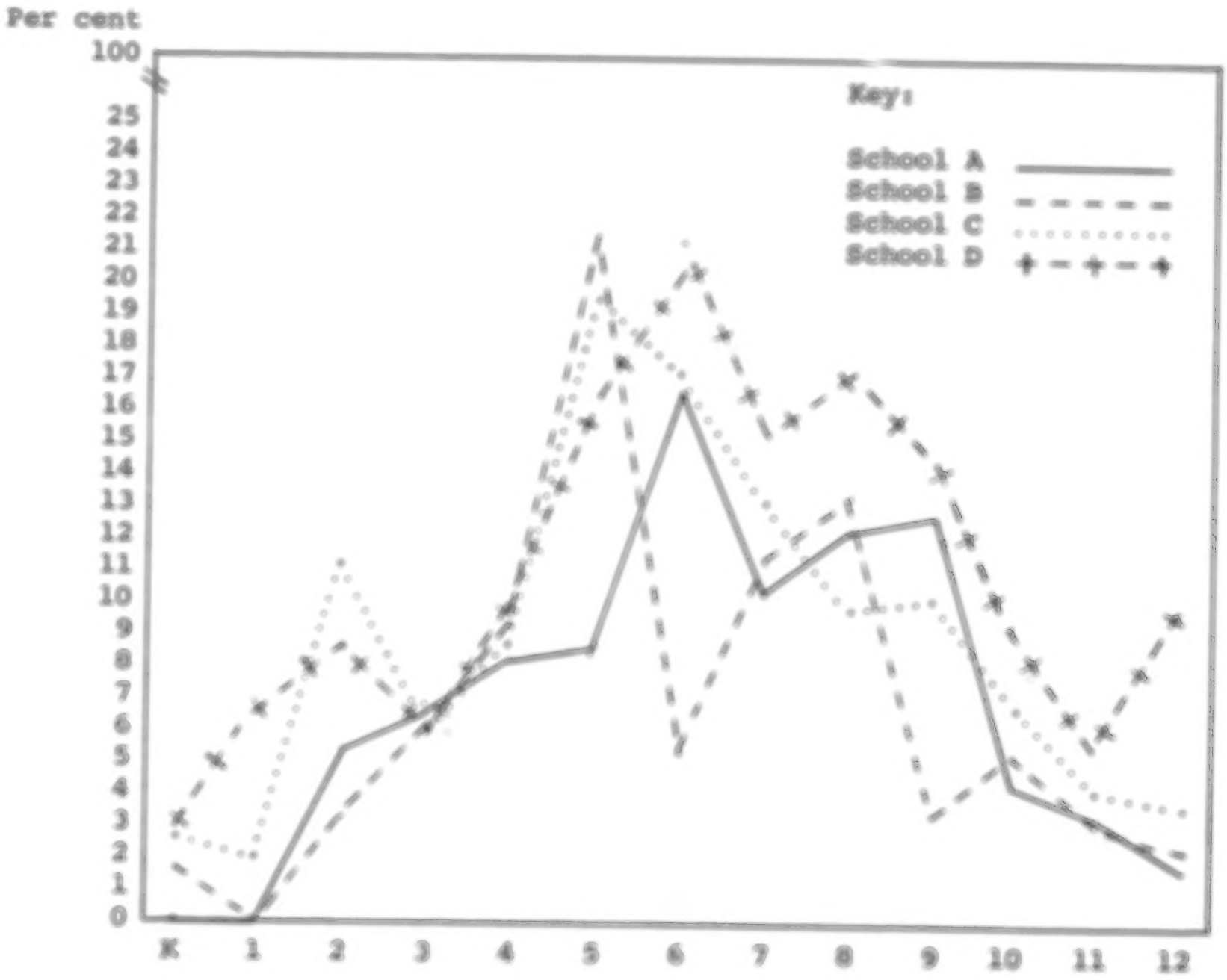

Fig. 2. Comparison of Students Referred per Grade in Four Schools.

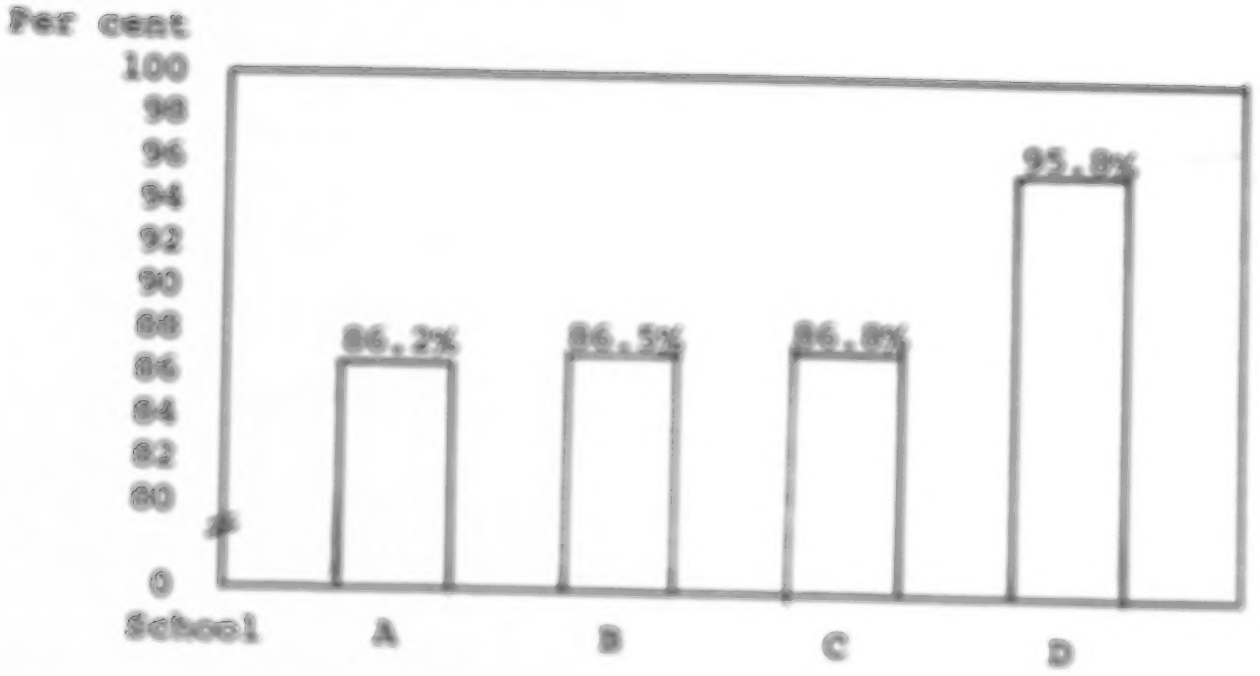

Fig. 3. Referred Students who Obtained Professional Examinations.

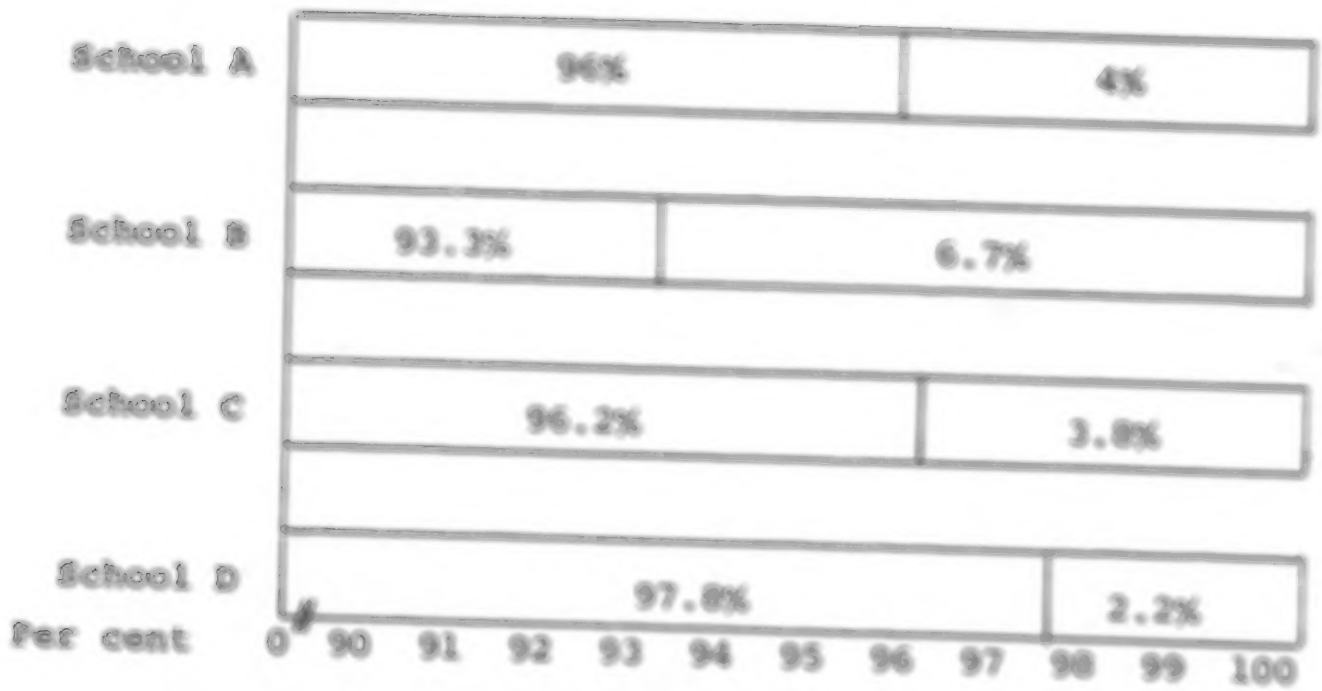

Fig. 4. Correct Referrals and Over-referrals.

process and who received treatment by eye specialists, and over-referrals, or those students who did not receive correction or treatment as a result of visiting the eye specialists. Students for which rechecking at a later date was recommended by the specialists were considered in the group of correct referrals, as was done in Michigan vision screening (Blackhurst, 1964). School A had 96 per cent correct referrals and 4 per cent over-referrals. In School B, there were 93.3 per cent correct referrals and 6.7 per cent over-referrals. Of the students referred from School C there were 96.2 per cent correct referrals and 3.8 per cent over-referrals. School D had 97.8 per cent correct referrals and 2.2 per cent over-referrals.

Table 5 is presented as a means for comparing the total number of students referred for each reason in the schools. The numbers of students who received treatment or correction from the eye specialists are shown as are the numbers of students over-referred or who did not obtain professional eye examinations. For example, in School C, 121 students failed distance tests. Of those students 99 received treatment or correction, four were considered over-referrals, and 18 did not obtain profes-

Table 5

Status of Referred Students

School	Referral Reason	Number Referred	Received Treatment	Over-Referred	No Appointment
School A	Failed Distance	58	48	2	8
School B	Failed Distance	52	42	3	7
	Failed Near-point	0	0	0	0
School C	Failed Distance	121	99	4	18
	Failed Near test	4	3	0	1
	Nurse's Observation	27	25	1	1
School D	Failed Distance	93	87	2	4
	Failed Near test	3	3	0	0
	Failed Muscle test	0	0	0	0

sional examinations.

Table 6 shows the information given in Table 5 converted to percentages to facilitate the evaluation for the reader. In Schools A and B all referrals were made because students failed the distance test. In School C, 80 per cent of the referred students failed the distance test, 3 per cent failed the near-point test, and 18 per cent were referred because of the nurse's observation of symptoms of eye problems. In School D, 97 per cent of the referred students failed the distance subtest, 3 per cent failed the near-point test, and no student failed the muscle balance test only.

Table 6

Status of Referred Students by Percentages

School	Referral Reason	Reason Referred %	Received Treatment %	Over-Referred %	No Appointment %
School A	Failed Distance	100	83	3	14
School B	Failed Distance	100	81	6	13
	Failed Near-point	0	0	0	0
School C	Failed Distance	80	82	3	15
	Failed Near test	3	75	0	25
	Nurse's Observation	18 *	93	4	4 *
School D	Failed Distance	97	94	2	4
	Failed Near test	3	100	0	0
	Failed Muscle test	0	0	0	0

*Due to rounding the totals are more than 100%.

DISCUSSION

None of the four vision screening methods used in the study gave strong evidence of being the best one. Similar results were obtained from each method. The largest percentage (11.15 per cent) of referrals was made in School D where the T/O School Vision Tester was used. Studies have shown that 20 per cent to 30 per cent of school children are in need of eye care. It was not expected that any of the schools would refer as many as 20 per cent of its students since no record was made in this study of the students already wearing glasses or receiving professional attention on a regular basis.

School B did not have any students failing the near-point test when a near-point card was used. It is questionable whether the time spent using the near-point card in screening could be more wisely used in some other part of the screening program such as in-service training for teachers or follow-up. School C did not refer any students on any subtests other than distance and near-point testing with the Keystone Visual-Survey Tests. The school nurse said that in the past there had been too many over-referrals for muscle imbalance. It

would appear that a new appraisal of the screening standards for muscle imbalance would be beneficial to the screening program. It is interesting to note the number of referrals from observation in School C. They are shown by percentage per grade in Table 3 and by number and percentage in Tables 5 and 6. The majority of these referrals are from the upper grades where students are more able to give information about what they see.

No students were referred because of failure on the muscle imbalance test in School D. The school nurse reported that several students had failed the muscle imbalance test after failing one or more of the other subtests. Since it is not necessary to continue testing after a student has failed one subtest, that information is not relevant to the study.

Figure 2 showed that the four screening methods produced similar patterns on the graph. It indicated that the majority of referrals occur when children are in third through ninth grades. Fewer referrals occur during the child's first and last years in school. Reasons for this may be because some eye problems are discovered when the children received their physical examinations prior to entering kindergarten or when the

students reach the legal driving age of sixteen. They are required to pass a vision examination to obtain a driver's license in Iowa. Many older students have regularly scheduled appointments and were not referred as a result of screening. To illustrate, in School A, 13 out of 63 eleventh graders had lens changes on regularly scheduled appointments, and no referrals were made for these students.

The four schools had high percentages, shown in Figure 3, of their students obtaining professional examinations indicative of good follow-up programs. Some students included in the group not having appointments do have appointments with eye specialists during summer vacation. If these students were included in the group obtaining professional examinations, the percentages would be even higher. The extremely high percentages of correct referrals, as shown in Figure 4, are both commendable and questionable. They are commendable because many of the students requiring treatment or correction of eye problems received it. They are questionable because, according to the literature, they indicate that under-referrals, students who passed the screening examinations but who actually need professional

attention, may be present.

Tables 5 and 6 give the numbers and percentages of students who failed each part of the screening tests and the numbers and percentages of those students who received professional care, were over-referred, or did not obtain professional examinations. It is evident that the Snellen test referred the majority of students who received referrals in all schools.

SUMMARY

In a four-county area of Iowa four different methods of school vision screening were used. Each of 22 school districts used one of the four methods at their own discretion. The four different methods of screening were compared in a study carried out for the purpose of finding, organizing, and giving information to nurses who requested it in order to set up and carry out vision screening programs.

A total of 4227 students in grades kindergarten through twelve in four schools were screened by one of four methods in the fall of 1966. Experienced school nurses did the screening in the schools. School A used the Snellen chart for distance vision. School B used the Snellen chart for distance plus the Reading Card - - Snellen Rating for near-point testing. In School C the Keystone Visual-Survey Tests were used, and in School D the T/O School Vision Tester was used for screening.

Information from the screening tests was compiled at the end of the 1966-1967 school year. The four testing procedures referred similar percentages of the students for professional examinations. The range was from 6.71 per cent in School B to 11.15 per cent in School D.

The four screening methods referred the largest group of students for professional examinations from the third through ninth grades. The Snellen test, a part of every testing method used, referred the majority of the students receiving referrals whether it was used as a wall chart or incorporated with a testing instrument. Subtests, other than distance acuity, of the optical instruments provided very few referrals.

Percentages of referred students who obtained professional examinations were high. Follow-up programs appear to be adequate. Correct referrals were extremely high, ranging from 93.3 per cent to 97.8 per cent. It is unknown whether students who passed screening tests yet needed eye care were present.

CONCLUSIONS AND RECOMMENDATIONS

No one best method of school vision screening has been identified in the literature, and the present study largely supports that finding. The Snellen test for distance acuity referred the most students in the present study and is the most highly favored in the literature. The Massachusetts vision kit is recommended if additional tests are preferred. Each school must choose the method to be used. A committee composed of the administrators, school nurse, local professional eye specialists, or other interested persons should define the goals of their vision screening program and choose the screening method which best meets those goals.

In a relatively small school the school nurse can do the vision screening alone or with the aid of teachers or volunteers. Any person doing the screening should be knowledgeable about the purposes and goals of the program. If teachers are expected to help with the screening, an in-service training program would be good before any screening is actually done. Vision screening should not be just an added chore for teachers. A checklist of symptoms of eye problems should be placed in the hands of each teacher in the school system. Since the classroom

teacher spends more time with the children than any other school employee, she should be able to identify symptoms of eye problems if they exist.

If the Snellen wall chart is used, the distance at which children stand or sit from the chart should be exactly twenty feet. A light meter could be used to check the proper illumination of the chart. The near-point card is not recommended for routine screening. If a test for hyperopia is preferred, the plus lens is recommended in the literature.

The subtests other than tests for distance acuity on the optical instruments gave very few referrals in the present study. Fear of over-referrals should not eliminate all referrals if some are warranted. More concern should be given to the students who are able to pass screening tests yet may have eye problems which hinder their best work in school. The concern shown in the past for over-referrals is unjustified according to the results of the present study.

The vision screening program should be an integral part of the school health program. Opportunities can be sought to include information about good eye health habits with instruction in good general health.

Excellent follow-up programs have existed and should be continued. There is nothing to be gained from identification of eye problems unless professional evaluations are obtained and recommendations are followed.

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